simpler instance, the tensions which allow the capsule of Impatiens to burst or the stamens of Parietaria to explode, are the product of vital activity, and have, moreover, an adaptive quality. But the release is purely mechanical; there is nothing like *perception* in the ordinary sense of the word, so that these phenomena differ from the reaction of Mimosa. Pfeffer, therefore, prefers not to consider the explosions of Mimulus, Parietaria, &c. as cases of irritability, while he acknowledges that there is no real objection to the word irritability having a wide enough meaning to embrace such cases. All that matters is that we should have a clear conception of the existence and importance of release action in the vegetable organism. Pfeffer points out that in his "Physiology" (1881) he laid down the same general principles that are developed in the present address, together with examples in various regions of change, and that even earlier, in his "Osmotische Untersuchungen" (1877), he expressed, without reserve, the same views as applicable to the phenomena of life generally. He claims for these views a practical priority in botanical literature, although he fully recognises that Dutrochet, in 1832, set forth perfectly clear and sound views on the subject.

In 1881, too, he used the word *Reiz*, *i.e.* stimulus-effect, as equivalent to physiological release-action; and he used the expression *Release* intentionally, because of the mystic conception attaching to the terms stimulus and irritability. In fact, he would at the present moment throw over altogether the word *Reiz* if it were not that the time has gone by for those mystic conceptions of life which are inconsistent with the law of the conservation of energy.

Pfeffer goes on to point out that when, in 1882, Sachs set forth his belief in the general existence of irritability, and in its necessity for the machinery of the organism, he spoke of it not as a phenomenon in the wider category of release-actions in general, but as a specific peculiarity of living organisms. Sachs, according to Pfeffer, holds the specific character of irritable organs to be not so much their unstable equilibrium as the fact, that after stimulation they return automatically to the labile condition. Pfeffer claims that this definition does not apply to many undoubted cases of stimulation. When callus is produced by injury, or when adventitious roots are developed in response to certain stimuli, there is no such automatic return, but a permanent alteration.

To produce a stimulus-reaction, a change in external or in inner conditions is necessary. The sensitive-plant does not react to steady pressure, but to variation in pressure. An analogous state of things is found when a plant in a condition of cold-rigor is made to grow by heat. For the change in temperature is merely a stimulus, since it only releases activities which are carried on by the energy at the plant's disposition, not by the heat. At a constant temperature the plant is in a statical condition of irritability, which is a necessary condition for the realisation of vital activity. If the results of temperature-changes are not generally recognised by botanists as phenomena of stimulation, this is only a proof of the need of accurate conceptions in this branch of physiology. The association of the word with strikingly visible phenomena is partly to blame for this. Everyone recognises that, for instance, in the opening of the crocus or tulip flower, the change of temperature is a stimulus. In these instances the action of heat may be compared to the regulation of certain machines of human construction by the heat-expansion of a metallic rod.

Even when the increased temperature, by increasing molecular action, brings about a union with oxygen, still the temperature-change is only the indirect cause of the combustion; and this reasoning applies to respiration.

In a similar sense the addition of a salt of potassium to a culture-fluid produces a release action in a plant in which growth was checked by the absence of this element.

Pfeffer has some interesting remarks on the condition of irritability of organs in a condition of equilibrium: for instance, on the continued action of the gravitation stimulus on a geotropic organ growing vertically. Bacteria are less sensitive to the attraction of meat-extract when themselves immersed in dilute extract; that is to say, the homogeneous medium, which has no directive action, shows its effect in diminished irritability. The same is true of heat, which stimulates when it varies, and which, when constant, is a necessary condition for certain states of irritability. The idea is not a new one, for no less a man than Johannes Müller (Pfeffer points out) defined the formal conditions of animal and plant life as *Lebensreize* or *integrirende Reize*.

The stimulus need not come from the outside, for just as a clock by internal machinery strikes at intervals, so in the organism combinations occur which function as stimuli for certain effects. These are naturally obscure, and for this reason we do well to fix our attention principally on external stimulation; but it can hardly be too much impressed on us that the development and ordered activity of the living body is inconceivable without the co-operation of stimulus from the inside.

With regard to stimulus and reaction, we are in the position of a man, ignorant of mechanics, who sets a machine in motion by a touch of his finger, and who has no idea whether the effect is due to a falling weight, to water-power, or to steam. Considerations of this sort make us realise our ignorance, so that when a new result is observed (in a case of stimulation) we do not even know whether the cause is to be sought in the perception of the stimulus or in the machinery of reply. While denying himself the discussion of cognate points, Pfeffer finds room to call attention to one or two interesting points of resemblance in the irritability of plants and animals. Thus, for instance, in plants as in man, an increase in the stimulus produces a dulling of sensitiveness. Just as a beggar is stimulated by the gift of a shilling, which on a rich man has no such effect, so a starving bacterium is stimulated to movement by excessively minute quantities of meat extract, while the same organism living in the midst of plenty can only be stimulated to similar movement by an absolutely greater quantity of extract. In the irritability of plants we find, in fact, the relations which are expressed in Weber's law—a proof that the relation in question has nothing to do with the higher psychic functions.

A plant or a plant-organ is never sensitive to a single stimulus only; thus during a geotropic curvature mechanical traction may bring about a strengthening of cell walls, and an injury may produce protoplasmic movement. Here lies a proof that different stimuli do not produce one and the same effect in a given cell, that, in fact, the cell does not react like our eyes, in which the most varied stimuli produce the effect of light. In the case of plants there can be no question of such a limited capacity—of specific energies in the sense of Johannes Müller.

The development of distinct organs of sense whose function is the perception of a single agent, is well known to be as little characteristic of plants as of the lower forms of animal life. But distinct organs of sense are no more a condition of irritability than they are of life. Indeed, plants exhibit a variety of sensibilities equal to that of animals, while in delicacy of perception the vegetable kingdom has the advantages. Bacteria are attracted by a billionth or trillionth of a milligram of meat-extract or of oxygen, infinitesimal quantities which we cannot weigh, and of which indeed we cannot form any adequate conception. It is just because the whole secret of life is contained in protoplasm, that the simplest organism, such as a bacterium, can be the theatre of as rich and varied a play of stimulus and reaction as the most complicated plant.

CHEMISTRY IN RELATION TO PHARMACO-THERAPEUTICS AND MATERIA MEDICA.

[By the courtesy of the editor of the *Lancet* we are able to give the following translation of an address delivered at the Eleventh International Medical Congress, by Prof. B. J. Stokvis of Amsterdam University.]

The Term and Scope of Pharmaco-Therapeutics.

"Therapy" or "therapeutics," by which terms we understand the art of serving the cause of humanity by assuaging human suffering and healing human ill, avails itself of every means in its power to arrive at these ends; *elle prend son bien où elle le trouve*. And the art of therapeutics, like all of us here assembled at this Eleventh International Medical Congress, has discovered that all ways lead to Rome. To Rome therapeutics has come—now in the guise of electricity, now as a water cure, now as psychical influence; so that we here are able to review, as they defile like armies before us, electro-therapy, pneumo-therapy, hydro-therapy, hypnopsis, and psychic suggestion, and compare their merits as healing agents when placing themselves at our orders to combat disease and put death to flight. But most ancient of all the branches of medical art is that which makes use of drugs; and in the hands of the inexperienced drugs can cause death (φαρμακεία—the use of medicines or poisons), so that the science and art of the introduction of medicaments into the human body with the view of healing it carry with due right the appropriate title of "Pharmaco-therapeutics." And at one time, pharmaco-therapeutics was the most important branch of the healing art, though in our days it has declined and occupies but a second, or perhaps, I should say, third place; operative surgery, proud of its victories, and as admired as admirable, full of vigour and sap, has distanced the ancient branch. And, again, we see hygiene, young, fresh, lovely, and assured beforehand of all suffrages, taking its place in the front of all medical science, confident in the future success of its attempts to render the arts of healing superfluous by preventing the malady. Why, then, it may be asked, do I essay to interest you in an art which seems to be growing old under our eyes; whose past, it is true, is very honourable, but whose future hardly seems to promise the triumphs that have fallen to the lot of surgery and of hygiene. My reply is simple—because we shall not be able to dispense with this essential branch of our art; because, as much in external as internal medicamentation, we must for the present make use of pharmaco-therapeutics.

The Prime Importance of Chemistry.

The substances that we employ in medicine are composed of chemical bodies, or are, perchance, pure chemical bodies; and to understand their physiological action we must have recourse to biology and chemistry; while to appreciate their application in disease it is necessary to study pathology and therapeutics. Chemistry, in its wide sense, enables us to understand the composition, the structure, and what I would term the affinities of a substance, as it is chemistry that enables us to analyse by tests, and to construct and reconstruct by synthesis. The relations between chemistry, on the one hand, and pharmaco-therapeutics and materia medica, on the other, are so intimate, so indissoluble, and so obvious that it almost seems to me superfluous to trouble you with their consideration. However, you will not mind, I hope, if I take the liberty of submitting to you a few points which may not be new, but which at any rate have the merit of being *apropos*, and may by thought upon them make us better appreciate chemistry. To pile stones on the top of each other is not to construct an edifice. Without a definite plan, without a general view—that is, a comprehensive conception of the whole constructive scheme—there can be no scientific edifice durably reared. Therefore, it would not be sufficient to constitute pharmaco-therapeutics a science to say that if it has arisen without preconceived ideas it is founded upon observations extending from the most ancient date with regard to the effects produced by the administration of certain substances to the sick; nor is it sufficient to claim that pharmaco-therapeutics has availed itself of experiments on healthy man and on animals, and has taken into consideration physiological results and the fruits of clinical study. A sound basis of operation from which to inquire into the use of medical substances is required. We must know, if we would satisfy the claims of science, the mode of action of these substances, and understand how it comes about that they possess the power to produce or remove functional troubles. And it is here that chemistry comes to our aid—chemistry in general, chemistry in its largest sense. I in no way lose sight of the incomparable services of biological chemistry and physiological experiment. Who of us would overlook the assiduous and successful work of Coppola, Gracosa, Pellacano, Albertoni, and of all that young Italian school that is now marching victoriously along the route traced out for them by Fraser and Brown? The method of action of medical substances has been and will be rendered more clear and comprehensible by their researches; but this is not enough. The conscientious striver after truth will always find himself face to face with one problem, a problem in the solution of which lie concealed—an inextricable secret so far—the true phenomena of life. We recognise this, for everywhere; where we are powerless to comprehend the action of medical substances upon the living organism as being due to their own inherent properties, we do not hesitate to call to our assistance the unknown properties of living protoplasm, and attribute the phenomena to them; but it is chemistry that should tell us that we must not be discouraged by the enigma of life. Enigma there is doubtless, but let us recall that Lavoisier first named life "a chemical function," and that—once given that the creature lives—from that it obeys neither more nor less than dead or material nature the general laws of chemistry.

Vital Phenomena and their Meaning.

The familiar phrases "living force" or "vital phenomena' serve us to design the outward expressions of condensed energy in dead material, being borrowed from the manifestations of life. In dead material, we are all aware, force can appear as thermal energy, as electricity, as light, or as mechanical expression, and we can go back along this line of transformations and see all the changes unmake themselves. In living protoplasm—considered as the unit of the psychic and reproductive functions—the essential phenomena are the same. There is the same change of *rôles*, the same production of warmth, electricity, mechanical energy, and chemical energy. We know that the living cell "reacts," as we please to term it, to variations of temperature, electricity, light, and energy, chemical and mechanical; but this irritability in the cell, this aptitude of the cell to change one form of energy for another, resembles the transformations that take place in dead material, as the stimulants of the living cell, without which the vital phenomena do not appear, are just the different forms of energy which arrive to it from its environment, and which it changes into chemical energy.[1] For life the cell must have warmth and moisture. Take away the moisture or lower the temperature to the necessary point, and life becomes latent or disappears. In dead nature the same takes place. We are all familiar with the admirable experiments of Prof. Pictet, bearing upon this point. He proved by them beyond dispute that chemical energy disappeared and reappeared in accordance with the temperature to which certain substances were submitted, and that water is every whit as indispensable as a proper temperature for the maintenance of the phenomena of life. Certain it is that life is a chemical function, but the point is—Is not the chemical function a sort of life? Did not the father of medicine show a wonderful insight in counting water and fire among the four elements of which the universe is composed?

Now if we examine closer the special problems which fall within the scope of pharmaco-therapeutics, if we examine the results which follow the introduction of drugs—healing or poisonous—into the organism of man and animals, it must appear that we can never learn how to solve the problems without looking for their explanation in these "vital elements," as I may term them. The manifestations of their agency in the behaviour of living organism have so characteristic an imprint that even Claude Bernard himself did not hesitate to place chemical and purely physical action in the comparative background. I will give examples of my meaning. How are we to understand the fact that the ingestion of infinitesimal quantities of certain substances which pass through the organism without causing in it the least change can provoke such disordered chemical actions as to occasion death? How are we to understand the fact that different parts of the organism seem to be able to distinguish these substances the one from the other? We must admit special elective functions proper to the life of the cells. How are we to understand the facts that nothing but a change in the quantity of their dosage, the duration of their administration, and the method of their application suffices to make of certain toxic substances stimulants or paralysants? How are we to understand the fact that insoluble substances like arsenic, cannabis indica, and lead can defy that well-known axiom, *Corpora non agunt nisi soluta*, and manifest therapeutic and toxic action. We must admit the presence and agency of some unknown power within the living cell. How, again, are we to understand the therapeutic power exhibited by solutions of iodine and bromine which have apparently been diluted to the deprivation of all chemical action, unless we attribute to the living cell the power of liberating the iodine and the bromine from such dilute solutions? Thanks to my compatriot and dear colleague at the University of Amsterdam, Prof. van t'Hoff, thanks to the admirable work of Arrhenius and of Ostwald, thanks to congresses of physicians and chemists, light seems to me to be about to be shed upon all these dark places in pharmaco-therapeutics. And it has not been Mahomet who has gone to the moun but the mountains which have come to him. In other words the study of the chemical affinities of dead matter has revealed to us the secrets of the living cell.

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[1] It must be remembered that all of this is qualified by Prof. Stokvis's original reservation, "Once given that the creature lives."

THE APPEARANCE OF "VITAL PHENOMENA" IN CERTAIN CHEMICAL SOLUTIONS.

We have been accustomed to regard the neutral solution of sugar or of some neutral alkaline salt in water as an inert liquid deprived of all molecular power. We know to-day that such a solution must be held to possess the same kinetic power as if the substance dissolved were present in the gaseous state. Placed in contact with other solutions it will exercise pressure according to the laws that Avagrado and Dalton have discovered for gas. It will exercise an osmotic pressure in direct proportion to its molecular weights. But this is not all. We have to remember the electrolytic phenomena of such solutions by which their kinetic power may be rendered enormous. This conception of the molecular properties of solutions is of the highest importance both in biology and pharmaco-therapeutics. It is not by accident that life is so closely leagued, as it were, to water. It is not by accident that living organisms contain without exception more water than solid properties, that they contain much more of it in proportion than any other terrestrial object of palpable and visible formation. It is not by accident that the youngest and most energetic organisms, those in which life is the most intense, are distinguished by containing the most water, while the tissues in which life is ready to expire have the least. Life has been compared to a torch. From a chemical point of view life is not only a torch—it may also be compared to a river. It is an ocean in which the molecules of the chemical substances there constantly dissolve, constantly develop chemical, electrical, thermal, and mechanical energy, an energy whose seat is the living cell.

From all of this it follows as an absolute necessity that the chemical actions which constitute vital phenomena become stimulated, troubled, or altogether upset from the moment that we introduce into the system some new complicated substances in solution, whose molecular forces are now added to those of the cellular system. We are only embarrassed what example to choose when we seek in organic and inorganic chemistries proof of this point. I only wish to name one to you which seems to me conclusive. By warming pure chlorate of potassium we obtain pure oxygen, but the presence of the smallest quantity of chloride of potassium is sufficient to change part of oxygen into ozone. In giving rise to this development of ozone the chloride of potassium remains itself completely unaltered; but, what is more remarkable yet, this chloride of potassium itself has, like peroxide of manganese—which acts in an identical manner—the property of destroying ozone.

We find, then, here, as M. Brunck, to whom belongs the honour of having discovered the reactions, has said, a most remarkable phenomenon. We see a chemical substance, without itself appearing to undergo the least appreciable molecular change, favours the formation of a new chemical body, which, on the other hand, it has the power to destroy the moment that it is formed. There is, in fact, in the domain of organic chemistry, with no question of fermentation, a catalytic force, in considering which we have to make for dead nature a complete pendant of that which should we scarcely consider characteristic for therapeutic actions—the phenomena of excitement and paralysis, manifested by the slightest possible quantities of one and the same substance which itself remains unaltered! And speaking always with these phenomena before our eyes and looking on the cell as a colloid or membranous mass containing several substances organic and inorganic at the same time dissolved in water, there is no longer any reason to be astonished that slight changes in the quantity of one substance or the other, or that the presence in one of a body that is absent in the other, suffice perfectly to change the chemical affinity of the cells, as well as to differentiate them in such a manner that each of them seems to be endowed with an elective affinity peculiar to itself. As for the manifestation of therapeutic and toxic action by bodies considered to be insoluble,, of which Nageli in a posthumous work has made so profound a study, they are also capable of the simplest interpretation. The insolubility of these bodies is not absolute, but only relative. If we throw, for example, metallic copper into water, and wait for some days, we shall find that a certain proportion of the copper has dissolved, *i.e.* one part to seventy-seven million parts of water. The copper dissolves in this manner without the least intervention of any living organism. In the same way it is not the vital function of the human organism which makes arsenic, cannabis indica, and lead, display active properties when introduced in a metallic state under the skin. It is the mass of water which is the agent (for the human body may be regarded as a jug of water containing forty-five litres) and the temperature.

The view that regards the solutions of salts as mediums in which the chemical molecules are perpetually striving to assert their individuality has contributed, on the other hand, in the most efficacious manner to elucidate the action of some of the drugs that are most in use. I have particularly in my eye now the purgative and diuretic salts, the chlorates, iodides, and bromides, whose therapeutic effects are obtained upon doses that may be called massive when comparing them with the infinitesimal doses of which we have just spoken. Since my dear and honoured colleague of the University of Amsterdam, Prof. Hugo de Vries, discovered the law of iso-tonic solutions, and since the admirable work of Prof. Hofmeister of Prague and his pupils, the effects of purgative and diuretic salts have been recognised to depend uniquely upon their pure chemico-physical properties. On the other hand, we owe to the zeal and perseverance of Prof. Hofmeister of Prague again a series of very beautiful researches on the imbibition of salt solutions by tablets of pure agar-agar gelatine, which demonstrate to proof that all that we have hitherto considered the elective affinity of the living cell can be explained in the most natural manner in the world by its colloid condition and chemical constitution. Add to this that the quickness of chemical action, according to the interesting chemical researches of Vladinarsky, is in no way impaired by the colloid state of the medium in which the substances are placed, and you will easily arrive at a conception of the immense progress that pharmaco-therapeutics has made by the agency of physical chemistry. Among the salts that I have named, the iodides and bromides are also to be found. Their therapeutic effects are, I need not say, altogether specific. What is more natural than the belief that we ought to attribute the results to the iodine and bromine themselves; and we all know that some long time ago, my colleague at the University of Bonn, Prof. Binz, has been able to demonstrate that it is the living cell which frees the iodine and bromine from solution. The fact is not, however, proved to universal satisfaction.

I should never finish my task if I tried to place before you all the points of the new view on the action of drugs, poisonous and otherwise, whose pharmaco-therapeutics are traceable to the theories of modern chemistry. Let us glance only at the catalytic fermentative action which takes place everywhere in live protoplasm, and which without doubt plan a preponderating *rôle* in the therapeutic effects of drugs. These can no longer be considered the appanage of the living cell. They also take place in dead matter.

CHEMISTRY IN RELATION TO MATERIA MEDICA.

If I now stop theorising it is not from fear lest anyone in this Areopagus of science should say: To what practical good does all this tend? Evidently it is not to-day or to-morrow that the art of medicine will profit by chemistry. But all these new ideas have rendered necessary new methods of experimentation, and new methods of investigation; and a new track is now being traced by human genius, along which there is much to discover; and from the moment that the new physical methods shall have been applied to the study of drugs (all honour to M. Dreser, who has here taken the initiative in his investigation into diuresis) medical art will profit and will find in chemistry a sure and trusty guide in its efforts to serve humanity.

In speaking of chemistry in its relation to materia medica I do not employ the words materia medica in the sense in which Dioscorides used them. I employ them in their strictest and primitive sense to mean the collection of drugs and medicaments in use in our days—our *thesaurus medicaminum.* Materia medica recruits from botany, zoology, and above all from chemistry; but its immense progress of late is due to chemistry. The active principle of almost all our drugs are now known to us. They have been isolated, prepared, and elaborated; the chemical constitution of their active principles is no longer a secret. We know that sugar and glucosides, and aromatic oils belong to chemical groups, and are as well defined as the alkaloids derived from pyridine or chinoline. Every day the number of contumelious substances—substances which do not wish to reveal to us their secrets—grows less. Chemistry has revealed to us the presence of more than twenty alkaloids in opium, and of more than six in quinine; and it will soon be extremely difficult to name the drug, of animal or vegetable origin, in which there have not been found one or several active principles. And, going from victory to victory, chemistry has also succeeded in producing a great number of alkaloids by the synthetic manner. These have not been the exceptional lucky strokes (*coups de maître exceptionels*). No constitution and composition of other bodies that chemistry has not yet reproduced for us is already familiar to the chemist who can transform morphia into codeia and *vice versa*, and worthless cupreine into effective quinine. We may predict with every confidence that the manufacture by synthesis of all the known alkaloids is only a question of time for chemistry. But the triumphal march of chemistry does not stop here; it has constructed for us new alkaloids endowed with therapeutic effects of great value. It has furnished us, *inter alia*, with apomorphine and apocolaine.

It would be unequalled ingratitude to fail to recognise the imperishable services that chemistry has rendered to materia medica in endowing it with the alkaloids and the pure active principles because there are a few black clouds on the horizon. That there are such I do not deny, but they are not wholly the fault of chemistry. Is the gunsmith responsible for the accidents that a new firearm may cause in the hands of a client who does not know how to use the weapon properly? Surely not. Why did not the purchaser take the trouble to understand the structure of the gun? Why was he not more careful? Why did he pay no attention to warnings? Why did he behave like a happy child, with nothing more important to do than to display his new acquisition to all the world and to put it to the test with the innocence of youth? On the other hand, should not the gunsmith help to avoid such disasters by explaining matters to the purchaser? And if he is not himself sufficiently informed and does not thoroughly understand the mechanism of the weapon, should he have offered it for sale? Either party may be to blame. What I want to convey by my parable is this: by a very pardonable illusion, to which the many physicians and some chemists have given way, it has become generally believed that the active principles of drugs, when chemistry can furnish them for us in a crystallised state, are purely chemical bodies, and that identity of name guarantees identity of chemical composition. This illusion is rapidly being dispelled, but, alas! not without having done harm to physicians and their patients. As far as the chemical purity of crystalline products is concerned, it is to-day a secret of Polichinello that crystallised quinine contains cinchonidine, that atropine contains hyoscyanine, and atropamine, and that pilocarpine contains jaborandi. As much in organic as in inorganic chemistry we come across this phenomenon of mixed crystallisation. The crystallisation of substances is no guarantee of their chemical purity. These facts are sufficient to condemn entirely the new therapeutic system that M. Burggraeve has wished to inaugurate under the name of "dosimetric medicine." Dosimetric medicine is doubly on the wrong track—first, in assuming the chemical purity of active crystallised principle of which it exclusively makes use, and secondly, in enunciating the therapeutic heresy that the administration of a single active principle is worth much more than the administration of the drug from which the active principle has been derived. I do not hesitate to describe this dosimetric profession of faith as a heresy. The drugs that are most used are admirably made compositions in which different principles, working for or against each other, are found together. Their therapeutic effect on the system is altogether different from the effect that would be obtained by adding and substracting the therapeutic effects of each ingredient. Recent pharmaceutic researches have conclusively demonstrated this fact. I do not wish to say too much against domestic medicine. I think it has been, on the whole, inoffensive. Alas! I cannot say as much of the unreasonable faith which leads persons to believe that similarity of name and of active principle in crystalline form will produce chemical and pharmaceutical identity. *Ingentem, regina, jubes renovare dolorem!* We all know the grievous results that may be caused by giving aconitine or digitalin derived from different sources. Here again the progress of chemistry promises improvement. The animal organism is most sensitive to stimulus, and modern chemistry has so many methods of stimulus at its disposal that the task will not be too arduous. It is a question which interests all civilised countries, which is brought forward at all medical and pharmaceutical international congresses, and which is in most urgent need of a satisfactory solution.

THE VAGARIES OF MODERN PHARMACY.

The services rendered by chemistry to therapeutics is not an exhausted subject. Certainly our predecessors already possessed a goodly medicinal treasury, but it seems very insignificant when compared with what we now utilise. Chemistry has loaded Materia Medica and Pharmacology with wealth; it is the mother of new remedies, and we are proud of its aid; it has given us our anæsthetics, antiseptics, hypnotics, and antipyretics. These groups of remedies enable us to give relief in many cases where our forefathers were quite helpless. To them chloroform, ether, carbolic acid, iodoform, creosote, chloral, the salicylates, antipyrin, were all alike unknown. But here, again, and more so than with respect to the alkaloids, there are shades in the picture. Chemists and chemical manufacturers add more and more to our store of remedies day by day without stint or truce, without heeding the great despairing physician already overstocked with drugs. We are tempted to cry out for mercy. This is no exaggeration, for these new chemical products are all forced upon the same therapeutic market under the most attractive names, and all proclaimed aloud with the noise of the most perfect advertising machinery. This is now done to an extent that, in my opinion, is detrimental to the interests of therapeutics. I am not speaking of quack remedies, the ovietara of our day, of these secret specifics which the medical man views with wholesome horror, to which, and to whose use, the old adage, *Trompeurs, trompés, trompettes* can be so well applied. I am speaking of genuine well-known products; for, unfortunately, modern and industrial chemistry, in manufacturing and in placing at the disposal of doctors these drugs, does not at all object to their being purchased by the general public. If this is not so, why do their proprietors select for their names the fascinating names that act as veritable flags to attract the public—for instance, anti-nervine, antiphthisine, anti-rheumatic, anti-dysenterine, and, most expressive of all, migrainine. I fully appreciate the difficulty of finding new names for these new products, and can understand that the manufacturer should shrink from giving them the names derived from their chemical composition, for these, generally speaking, could only be pronounced with linguistic gymnastics and intolerable strain upon our memory. I must, with great regret, note that we have departed from the ancient method, which taught us to denominate new products according to their origin, and we have followed freely a course that I cannot blame too severely—that of seeking for euphonious, sonorous names, pompously proclaiming the therapeutic use and effect of the drugs designated by them. It is not sufficient nowadays to have a good remedy—say agathine;—we must be assured of its superlative excellence, hence aristol. Do you want to prescribe for a patient who is "out of sorts," you have euphorine; for a lack of appetite, you have orexine. You desire to procure sleep for him: you have hypnal, hypnon, somnal, or somniferine. You wish to lower a febrile temperature: do not let the emergency trouble you, for you have antipyrine, antifebrine, antithermine, thermomine, thermofugine, pyrodine, and thermodine. You want to assuage pain? *Eh bien*, you have awaiting your orders analgesine, analgeine, exalgine, exodyne, and neurodyne. Or you desire to stimulate urinary secretions, you have diuretine, pheduretine, and uropheime. To check the formation of pus there is a remedy termed pyoktonine; and to combat spasms antispasmine. I do not wish to exhaust your patience, and I will spare you the enumeration of the antiseptics, the disinfectants, the microbidines *e tutti quanto*. Ten years exactly have elapsed since my honoured colleague, Prof. Rossbach of Jena, published an article full of wit and sound sense in ridicule and blame of these tendencies of modern therapeutics, and in those days we had not the long lists of antiseptic and antipyretic remedies. Nor was it then imagined that the essential extracts of the organs of animals, of which the late Prof.

Brown-Séquard and M. C. Paul were the earliest to explain the therapeutic value, would find a place in materia medica, nor cultures of microbes. It was not foreseen that we should have to chronicle in 1894 the sale not only of sequardine, but also of veritable bacterial products such as tuberculine, tuberculocidine, antituberculine, antitoxine, κ.τ.λ. How shall we check the fury of this flood? There seems no reason why it should ever come to an end.

TRANSPARENT CONDUCTING SCREENS FOR ELECTRIC AND OTHER APPARATUS.[1]

It is well known that electrostatic instruments require to be screened from outside electric disturbance, in order that their indications may be correct; but it is not so generally recognised that instruments intended to measure small forces, such as certain types of *electro-magnetic* voltmeters, delicate vacuum gauges, &c. are liable to give wrong readings from an electric attraction being exerted on the pointer, such as is produced by the glass cover when it is touched or cleaned.

There is on the table here a well-known type of gravity *electro-magnetic* voltmeter, which may be found on the switchboards of many English and continental electric light stations. At the present moment its terminals are not connected with the electric light mains of the building, so that it should indicate zero pressure. Let me, however, but stroke the right-hand side of the glass cover with my finger, and the pointer, as you see, at once turns to eighty volts or more. Conversely, let the terminals of the voltmeter be connected with the electric light mains; the pointer should point to about 100 volts, for that, as you know, is the pressure supplied by the Westminster Company. The voltmeter appears to be indicating correctly, but, on stroking the left-hand side of the glass cover, the pressure, as read by the instrument, appears to suddenly fall to some forty volts. And a similiar effect is produced if a piece of wash-leather or dry waste be used in place of the finger.

If, then, it is possible to cause this instrument to indicate at will sixty or eighty volts too high or too low, how impossible must it be to feel sure that the glass cover—which is, of course, maintained in a dry condition in a hot engine room—has not been electrified by some accidental touch of the coat sleeve sufficiently to cause an error of three or four per cent. in the reading of this voltmeter!

We find that it is not merely with this particular type of voltmeter that an error can be produced by stroking or rubbing the glass cover, for other electro-magnetic instruments that we have tried can also have their pointers deflected in the same way, but not to the same extent.

Nor, of course, is this source of error in any way connected with a voltmeter being an instrument constructed to measure an electrical magnitude, for it would equally exist if the glass were clean and dry and the controlling force remained of the same magnitude, no matter what was the quantity the instrument was constructed to measure. For example, on the table there is a vacuum gauge the wheel-sector-pinion of which has been replaced with an Ayrton-Perry magnifying spring. This gauge is, no doubt, very sensitive, for you observe that the pointer moves even when I produce an extremely slight diminution of pressure by rotating the short length of india-rubber tube as slowly as I can; the change of pressure on pinching the tube, or even on dropping it, is indicated by the pointer. On the other hand, the pointer is of glass, and therefore is not suitable for being acted on by an electrostatic force; still, a stroke on the glass cover, as you see, causes the pointer to deflect through several degrees.

It has been known for a long time that it is possible to screen an instrument from such outside electrostatic disturbances by surrounding it with a metallic cage composed of wire or of strips of tinfoil. Such a method of screening, however, has the great disadvantage that it renders it difficult to observe the exact position of the pointer from a distance, for the wires or strips of tinfoil cover up the pointer more or less. We therefore thought of placing the pointer underneath the metallic dial of our electrostatic voltmeters, and of only allowing the tip to project through a slot in the dial plate. But this method we abandoned on trying it eighteen months ago, for to make the screening good the visible part of the pointer must be reduced to a spot, and the exact position of this spot we found less easy to read at a distance of several feet than that of a long black line, which is the appearance of a pointer when it is visible along its whole length. This method of screening has, however, we understand, been recently adopted by a firm of instrument makers.

We next considered whether it was not possible to make a perfectly transparent conducting screen, so that, while the electrostatic screening of the pointer should be practically perfect, the pointer and dial should be as easily seen as if the screen were not present. Our first idea was to make the glass cover double, and to insert between the two sheets of glass a layer of clear conducting liquid. Fearing, however, trouble from leakage of the liquid, or from the liquid becoming gradually turbid and giving the dial a dirty appearance, we turned our attention to depositing films of solid matter on the inside of the glass cover, or shade, of sufficient thinness to be practically transparent, but with the solid particles near enough together to be conducting. We tried smoke, silver deposited in layers of various thicknesses, mercury vaporised and deposited, sal-ammoniac vaporised and deposited, &c., but we were quite unable to obtain in this way both transparency and electric conduction.

After a conversation with Prof. Boys, when discussing the problem that we were then engaged in solving, we commenced experimenting on varnishes, with the view of arriving at a varnish which should be as hard and as transparent as *clear* shellac, but which, instead of being an insulator like shellac, should be a sufficiently good conductor to allow of the instantaneous production of an induced electric charge to balance the electrostatic action of any outside body. Glass plates were coated with gum, with coaguline, with the gelatinous electrolyte used in accumulators (composed of sodium silicate and dilute sulphuric acid), with isinglass dissolved in acetic acid, with gelatine dissolved in acetic acid, with isinglass dissolved in a mixture of acetic and sulphuric acids, and with gelatine dissolved in the same mixture. After much experimenting, we arrived at the following two methods of coating a glass cover, or shade, which gives perfectly satisfactory results:—

No. 1.—Dissolve $\frac{1}{4}$ ounce of transparent gelatine in 1 ounce of glacial acetic acid by heating them together in a water bath at 100° C. To this solution add half the volume of dilute sulphuric acid which has been prepared by mixing 1 part of strong acid with 8 of distilled water by volume, and apply the mixture while still warm to the glass shade, which should be previously polished and be warm. When this film has become very nearly hard, apply over it a coating of Griffith's anti-sulphuric enamel.

Method No. 2.—Thin the gelatine solution, prepared in the manner previously described, by the addition of acetic acid (say 2 volumes of acid to 1 of the solution), and, after polishing the glass, float this thinned solution over the glass cold. Drive off the excess of acetic acid by warming, allow the glass to cool, and repeat the floating process, say, twice. Thin the anti-sulphuric enamel by the addition of ether, and float it over the gelatine layer applied as just described. Expel the ether by heating, and apply a second layer of this thinned anti-sulphuric enamel.

With experience, such as Messrs. Elliott and Messrs. Paul have at length acquired after much practice, a layer can be applied, either according to method No. 1 or No. 2, so that, when finished, it is quite hard to the touch, and so transparent that it is only by looking at the glass plate obliquely that the presence of the varnish can be detected. It is also so conducting that when a P.D. of several thousand volts, alternating with a frequency of 200, is set up between the needle and inductors of one of our electrostatic voltmeters, the pointer, which is metallically part of the needle, is not visibly attracted by a metallic rod held just outside the glass close to the pointer, this metallic rod being electrically connected with the stationary inductors.

Without experience, however, it is somewhat difficult to apply the coating so that it is not either cloudy, or a comparatively poor electrostatic screen, or both.

This second electro-magnetic voltmeter—which, like the former, has been kindly lent us by Mr. Barley, of the Knightsbridge electric light central station—looks exactly like the other one, and, indeed, behaved exactly like the other one when we received it. It has, however, had a layer of our transparent varnish applied on the inner side of the glass subsequently, and you will find that you may rub the glass as much as you like, or even hold a rubbed

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[1] A paper by W. E. Ayrton, F.R.S., and T. Mather, read at the Institution of Electrical Engineers on April 12.